DOUBLE ACTING APPARATUS AND METHOD FOR EJECTING WORKPIECES FROM FORMING MACHINES

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 60/245,787, filed November 3, 2000.

FIELD OF THE INVENTION

The present invention broadly concerns metal forming machines and, particularly, ejector apparatus and methods for ejecting a workpiece from the metal forming machine. More specifically, however, the present invention is directed to the ejector apparatus for use with lid seamers for ejecting lidded containers such as those made with a fiberboard, metal or plastic side wall and a metal lid seamed on a top rim thereof.

BACKGROUND OF THE INVENTION

The use of automated machinery to perform machining functions on workpiece has become an essential part of modern manufacturing technology. In such automated equipment, it is typical that one or more forming stations are provided. A workpiece is advanced into engagement with the forming station by means of a positioning mechanism. Upon retraction of the positioning mechanism, the workpiece is ejected from the forming station so that the metal forming cycle can be repeated. Ejection of the formed workpiece is accomplished by gravity or, in some instance, by an ejector rod that may, for example, be mechanically actuated to apply a jarring force to the workpiece to eject the workpiece from the forming station.

A specific example of such a machine adapted to perform a machining function, and the type of machine to which the present invention is particularly directed, is a lid seamer. Such seamers are typically of a type used for concentrated juices, meat products, oil containers and the like. Here, the container has a plastic, metal or fiberboard sidewall affixed to a bottom end. The bottom end is seamed to the lower sidewall rim before filling. The sidewall has an upper rim that defines a mouth so that the container may be filled with product. After filling, a lid is registered with the upper rim so that the combination lid and rim are seated on a chuck assembly as a workpiece. One or more forming rollers then revolve around the chuck element to seam the lid onto the container to produce a sealed, lidded container that is then ejected for further packaging, as desired. The workpiece is generally moved into position through the use of a star-wheel apparatus. In some instances, a threaded pull strip is provided around the rim and is seamed at the lid/sidewall interface concurrently with the lid to provide a structure for ease of opening the finished container. The standard ejector mechanism is in the form of a knock-out rod which is cam-actuated so as to be mechanically timed to tap the center of the lidded container thereby to eject it from the chuck assembly in the forming station.

Use of knock-out rods of a type typically employed in the industry is not without its problems, however. Where the sidewall of the container is constructed of fiberboard or plastic, a greater knockout force is employed due to increased friction between the container

sidewall and the star wheel apparatus. Lids for these containers can even have an undercut (about 3° to 7°) which may aid the release of the lidded container from the chuck after seaming. Even where only a slight force is necessary to eject a lidded container, the impact of the knock-out rod on the center of the formed container can damage the lid causing scratching, denting, contamination, loss or degradation of the product.

Several other disadvantages arise from the use of a knock-out rod. One such disadvantage is the fact that the knock-out rod along with its associated mechanical structure, including cam followers, cam grooves and the like, greatly increase the complexity of most lid seamers. Thus, such machines are expensive and costly to maintain. Moreover, since the knock-out rod reciprocates in an assembly mounted on the center of the forming chuck, it is necessary to lubricate the knock-out rod and its associate bushings, bearings, etc. The presence of lubricants always presents the problems of leakage that, in rare instances, might contaminate the product in the container or soil the container lid. Further, the inertial mass of the reciprocating knock-out rod and its associated mechanical linkages acts as a limit on the speed at which such machines can operate.

In my United States Patent No. 5,533,853 issued July 9, 1996, I disclose an improved ejector apparatus and method for machines in general and especially lid seamers, which utilizes a resilient element mounted on a chuck. The resilient element is positioned so that, when the workpiece is in an engaged position, a portion of the workpiece

engages the resilient element to collapse the resilient element. When the positioning mechanism retracts, the resilient element exerts a restorative force on the workpiece thereby to eject the workpiece from the forming station. In this patent, it is preferred that the resilient element be polymer-based.

Where containers are made of fiberboard or plastic, or in some instances metal, a greater amount of work (as defined by force acting over distance) may be necessary due to the dimensions of the lid, the above noted undercut and other geometry of the machinery. I have learned that, when ejecting such a container from a lid seamer, it is desirable to have a stronger force acting over a relatively small distance to initially eject the container from the chuck but to also have a lesser force acting over a longer distance to completely insure dislodgment of the lidded container after the seaming operation and before gravity can be effectively implemented to discharge the container. Thus, despite the advances described in the above-named patent, there is a need for improved ejector apparatuses, especially as applied to ejector apparatuses, machines using ejectors, particularly lid seamers, used in the production of fiberboard, plastic or other containers. The present invention is directed to meeting these needs.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a new and useful improvement to machines that require ejector mechanisms that assist in ejecting a workpiece from a forming station.

Another object of the present invention is to provide an ejector apparatus that reduces the complexity of the forming machinery.

A further object of the present invention is to provide apparatus and a method employing a double acting resilient ejector for use in ejecting workpieces from forming stations.

Another object of the present invention is to provide an ejector apparatus and method for lid seamers which reduces the incidence of contamination by lubricating media.

Yet another object of the present invention is to provide a new and useful chuck assembly incorporating an ejector apparatus that may retrofit onto existing machines, especially lid seamers, that reduces the cost of maintaining such machinery.

Still another object of the present invention is to provide a new and useful ejector apparatus especially suited for use with forming machines used for the formation of fiberboard, metal or plastic side wall containers with seamed tops and bottoms, such as metal end caps.

A further object of the present invention is to provide an improved method and improved ejector apparatus which may allow automated machining functions to proceed at greater speeds.

Yet another object of the present invention is to eliminate traditional knock-out rods and associated parts from lid seamers thus reducing the parts count of the seamers.

According to the present invention, then, a resilient element is provided for a chuck assembly with this chuck assembly being adapted to mount in a machine that performs a machining function on a

workpiece. Such machine has at least one forming station including at least one forming roller and at least one chuck element having a forming surface cooperative with the forming roller to perform the machining function. The machine also has a positioning mechanism operative to advance so as to move the work piece from a disengaged position through an intermediate position and into an engaged position so that the machining function can be preformed. The positioning mechanism retracts so that the workpiece can be ejected from the forming station. An example of such a machine is a lid seamer or other machine to place an end closure on a container body, such as used in the food and beverage industry.

The resilient element then forms an improvement to this chuck assembly, and thus, such machines. The resilient element is formed of a flexible, compressible first material and is mounted to the chuck element and positioned so that, when the workpiece is in the intermediate position, a first portion of the resilient element is operative to apply a first force to the workpiece. When the workpiece is in the engaged position, a second portion of the resilient element that is different from the first portion is operative to supply a second force to the workpiece. Thus, as the positioning mechanism retracts, the first and second portions of the resilient element exert first and second restorative forces, respectively, on the workpiece thereby to eject the workpiece from the forming station.

The first portion of the resilient element is defined by a central region, and the second portion is defined by a marginal region. The

marginal region is formed as a peripheral lip extending around the perimeter of the resilient element and has a thickness that is greater than the thickness of the central region. A head structure is provided on the central region. This head structure may be an integral one-piece construction with central region. For example, the head structure can include a rounded contact surface to contact the workpiece when it is moved from the disengaged position toward the intermediate position. Alternatively, the head structure has a flat contact surface to contact the workpiece when it is moved from the disengaged position toward the intermediate position. In one embodiment, the head structure is defined by a plug disposed on the central region. This plug has an enlarged head, in the form of a button, that is supported on an elongated, axial shaft. This axial shaft extends through a hole in the central portion and may be retained thereon by means of a locking washer engaging vanes on the shaft of the plug. Here, the plug is formed of the second material different than the material used to construct the resilient element, and this material may be labrusish material, such as nylon. In addition, the central region may be prorated with a stanchion, such as an annular ring formed integrally with the central region, so this stanching ring may support the button portion of the plug.

The resilient element, along with the chuck element of the present invention thus forms a chuck assembly. The chuck element then is mountable to the machine. The chuck element has a rim that provides a forming surface that cooperates with the forming roller to

perform the machining function and a recess is bounded by this rim. The resilient element is then mounted to the chuck element and disposed in the recess. To accomplish this, the chuck element may have a groove formed in the recess proximately to the rim such as the groove is bounded by the rim in an inner groove wall. One wall of the groove can be formed a large acute angle relative to a transverse plane that is orientated perpendicularly to the central axis of the chuck assembly. The resilient element then includes a ridge structure that projects away from a first side thereof. The ridge structure can be formed in a large acute angle so that the ridge structure and the groove may be snap fitted together. This ridge structure is thus operative to be matably received in the groove thereby to secure the resilient element in a fastened state to the chuck element with the marginal region supported against an exposed surface to the inner groove wall.

The chuck assembly can have an axial passageway extending therethrough in communicating with the recess. When mounted, the central panel region of the resilient element extends transversely across this axial passageway with a marginal region being formed as a peripheral lip extending around the perimeter of the resilient element. The central region of the resilient element then has at least one vent port formed therethrough and can include a plurality of vent ports formed equiangularly around the axis.

The present invention also then is directed to a method of ejecting a workpiece from a machine of the type described above. This method includes the steps that are inherent in the above described

structure. Broadly, the method includes a step of securing a resilient element in fixed relation relative to the chuck element in the machine in a manner such that a central portion of the resilient element will be contacted by and deflected by the workpiece when the workpiece is moved into the intermediate position thereby to exert a first restorative force tending to eject the workpiece from the chuck element. The method then includes advancing the positioning mechanism so that the workpiece moved from the intermediate position into the engaged position simultaneously compressing a margin portion of the resilient element thereby to exert a second restorative force tending to eject the workpiece from the chuck element. The method then includes the step of holding the workpiece in the engaged position against the restorative forces until the machining function is completed and thereafter retracting the positioning mechanism to allow the resilient element to rebound to eject the workpiece. The resilient element is constructed so the first and second restorative forces applied thereby are sufficient to eject the workpiece from the forming station after the machining function is preformed thereon. In this method, the machine may be a lid seamer wherein the machining function is seaming an end closure onto a container body.

These and other objects of the present invention will become more readily appreciated and understood from a consideration of the following detailed description of the exemplary embodiments of the present invention when taken together with the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view in partial cross-section showing a lid seamer according to the prior art for seaming a lid onto a fiberboard, metal or plastic container;

Figure 2 is a perspective view of a chuck element with which the present invention may be used;

Figure 3 is an exploded view in partial cross-section of the chuck assembly shown in Figure 2 along with a resilient element to be mounted thereon;

Figure 4 is an exploded perspective view of the first exemplary embodiment of the resilient element according to the present invention;

Figure 5 is a side view in cross-section showing the mounting of one edge of the resilient element and the chuck element of the first exemplary embodiment of the present invention;

Figure 6(a) is a side view in partial cross-section showing a container engaging the chuck element of the first exemplary embodiment of the present invention in a fully engaged position;

Figure 6(b) is a side view in partial cross-section showing a container engaging the chuck assembly according to the first exemplary embodiment of the present invention in an intermediate position wherein the container is partially engaged with and partially disengaged from the chuck assembly;

Figure 6(c) is a side view in partial cross-section showing a container and the chuck assembly according to the first exemplary

embodiment of the present invention is in a disengaged position with the chuck just releasing the container into a released state;

Figure 7(a) is a diagrammatic side view showing the mechanical equivalent of the resilient element according to the first exemplary embodiment of the present invention in a fully engaged state;

Figure 7(b) is a diagrammatic side view of a mechanical equivalent of the resilient element of the present invention shown in the intermediate state;

Figure 7(c) is a diagrammatic view showing a mechanical equivalent of the resilient element of the present invention in the released state;

Figure 8 is a side view in cross-section showing the chuck assembly of the present invention along with a second exemplary embodiment of the resilient element; and

Figure 9 is a side view in cross-section showing the chuck assembly of the present invention with a third exemplary embodiment of the resilient element according to the present invention.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

The present invention is directed generally to the metal forming machines that include forming stations operative to receive workpieces for performing a machining function thereon. Of particular concern of the present invention are improvements to the method and apparatus for ejecting a workpiece from such a forming station. Thus, the present invention is directed to new and useful embodiments of resilient ejectors that may retrofit onto existing chuck assemblies for such

machines and, furthermore, to the combination of improved chuck elements with improved resilient ejectors. Thus, the present invention provides both retrofit capability for existing machines as well as to the improvements to original (O.E.M.) equipment.

The present invention is particularly directed to ejector apparatus and methods for use with lid seaming machines of the type operative to seam or join lids or other end caps onto containers such as used in the food and beverage industry. Thus, for purposes of example only and not for limitation as to the overall scope, this invention will be described hereinafter in conjunction with a lid seaming apparatus for a container, such as a container that has a fiberboard, metal or plastic sidewall. An example of a type of product is a can for frozen juice concentrate. It is to be clearly understood from the outset, though, that the exemplary embodiments of the present invention and the methods employed could be utilized on other types of machine forming equipment, especially those incorporating ejector rods. Moreover, while the container body is shown to be cylindrical with the end closure (or lid) correspondingly circular, it should be understood that rectangular (including square), oval or other shaped containers and closures as now known or later developed are within the scope of this invention requiring modifications within the skill of the artisan.

In order to better understand the present invention; it is first helpful to review a standard-type of forming station used in the beverage can industry. Thus, with reference to Figure 1, it may be seen that a standard lid seamer 10 includes an elongated spindle 12 that is fixedly mounted to

the machine such as by a housing or turret (not shown). A chuck element 14 is threadably mounted on a distal end of spindle 12 and includes a working surface 16 that interacts with a forming roller 18 to seam a lid 20 onto a container, such as concentrated juice container 22. Chuck element 14 and forming roller 18 thus define a forming station, and lids 20 are delivered to this forming station by means of gravity feed 24. Unlidded containers 22 are moved into position with the forming station, for example, by star wheel 26 (shown in phantom). A push pad 28 reciprocates in the direction of arrow "A" and thus provides a positioning mechanism operative to first advance so as to move container 22 into a engaged position with the forming station and then to retract whereby the lidded container is ejected from the forming station.

To assist in ejecting the lidded can from the forming station, it is common practice to form a longitudinal passageway 30 through spindle 12 to reciprocally mount a knock-out rod 32 therein by means of suitable bearings and bushings. Accordingly, chuck element 14 has a central, axial opening 34 that registers in axially alignment with longitudinal passageway 30 so that head 36 of knock-out rod 32 may protrude through opening 34 so as to selectively contact lid 20 thereby to assist in ejecting the lidded beverage can from the workstation.

To supply the knock-out or ejection force, an end 38 of knock-out rod 32 opposite head 36 is connected to a mounting block 40 which in turn is secured to a cam follower 42. Cam follower 42 includes a roller 44 received in a camming groove 46 formed in turret portion 48 so that, as the forming station revolves around stationary turret portion 48 in the

direction of arrow "B", block 40 and thus knock-out rod 32 reciprocates in the direction of arrow "C" according to the amplitude of undulating camming groove 46, as is known in the art.

As noted in the background of the description, the use of a knock-out rod 32 has disadvantages. The impact of head 36 on the lid 20 of container 22 caused by the reciprocating mounting block 40 can scratch or dent the lid or even rupture the seal of the lid thus exposing the contents of container 22 to contamination. This contamination can be in the form of intrusive materials, including bacteria or other microbes. Additionally, longitudinal passageway 30 is necessarily supplied with a lubricating medium, such as oil or the like. Any leakage through the bearings, seals or bushings associated with spindle 12 and knock-out rod 32 can contaminate the outer surface of lid 20 and, where the edge seal is violated, can possibly contaminate the contents of container 22. The present invention contemplates elimination of the entire push rod assembly, including push rod 32, mounting block 40 and cam follower 42. This also can possibly permit faster machine speed by eliminating the inertial mass of the knock-out rod and its associated mechanical linkages. The present invention further helps control the lid/end closure during registration with the container body. Accordingly, it should be appreciated that the invention can be employed either in the manufacture of original equipment or as a retrofit structure, explained more thoroughly below.

With reference to Figures 2-5, therefore, a first exemplary embodiment of the present invention is shown in the form of a chuck

assembly 110 including a chuck element 120 and a resilient element 150. With reference first to Figures 2 and 3, it may be seen that chuck element 120 is in the form of a generally cylindrical tool having a surrounding sidewall 122 so that a longitudinally extending passageway 124 is formed therethrough. Chuck element 120 is constructed identically to that described in my U.S. Patent No. 5,533,853, the contents of which are incorporated herein by reference. It should be understood, however, that differently configured chuck assemblies could be used. For example, lid seaming machines with chuck assemblies are used for rectangular (including square) cans and oval cans, such as those used to package meat products. Other seaming machines employ chuck assemblies for cans provided with pull tab openers (such as beverage cans, some pet food cans, sardine cans, etc.).

In any event, an inner wall of sidewall 122 is threaded at 126 so as to be threadably received on the threaded end of spindle 12. Returning again to Figures 2 and 3, it may be seen that sidewall 122 includes a plurality of spanner ports 128 so that a wrench may be engaged with chuck element 120 so as to allow loosening and tightening of chuck element 120 onto spindle 12.

A distal end 130 of chuck element 120 includes recess 132 surrounded by an upstanding peripheral rim 134. Recess 132 communicates with a central opening 136 by way of passageway 124 centered about longitudinal central axis "X". Thus, peripheral rim 134 extends around one end of chuck element 120. Where the chuck element 120 is circular, then, the rim 134 extends circumferentially

around the end with rim 134 having an exterior forming surface 138 which cooperates with forming roller 18 to join or "seam" a lid 20 onto an upper rim of container 22. An annular groove 140 is formed (such as by machining) in recess 132 along the periphery thereof proximate to upstanding rim 134. Annular groove 140 thus has an inner groove wall 141 with an exposed support surface 143. Rim 134 and inner groove wall 141 together bound groove 140.

Resilient element 150 is best shown in Figures 3-5. As is shown in these Figures, resilient element 150 includes a compressible, resilient, flexible body 152 having a first portion in the form of central panel section 153 generally having a first thickness “t_1”. An annular ridge structure 154 projects away from a first side 156 of central panel 153. Ridge structure 154 is sized and adapted to be matably received in annual groove 140 of chuck element 120 thereby to secure resilient element 150 in a fastened state in a recess 132 of chuck element 120. Ridge structure 154 has a wall 158 formed at a large acute angle relative to the plane “P” of central panel 153. This allows ridge structure 154 to be snap-fitted into engagement with annular groove 140.

Resilient element 150 includes a second or margin portion defined by a radially outwardly projecting peripheral lip 160 that extends around an outer, exposed perilmeter edge of central panel 153. An annular shoulder 162 extends around the interior 155 of resilient element 150 adjacent to but radially inwardly of ridge structure 154. Accordingly, resilient member 150 provides an active spring

region 164 located between annular edge 168 of central portion 153 and shoulder 162 as a margin portion of resilient element 150. A spring region 164 is formed of a thickness "t_2" that is greater than "t_1". Spring region 164 provides an ejecting force, when compressed, as described more thoroughly below. An annular ring 170 is located on the exterior surface of central portion 153 of resilient element 150 and has an axial bore 172 through which a shaft 174 of plug 180 is inserted for mounting.

With reference to Figure 4, the construction and assembly of resilient element 150 may be seen in greater detail. Here, it may be seen that resilient flexible body 152 is sandwiched between plug 180 and a locking washer 190. Flexible body 152 is preferably formed of a polymer material such as neoprene, EPDM or other durable, flexible, compressible, and resilient material. Further, body 152 is constructed to have the configuration described above. Plug 180 has an elongated axial shaft 174 provided with a plurality of radially projecting, resilient vanes 182 and an enlarged button or head 184 constructed as an annular disk. Plug 180 is integrally molded as a single piece out of nylon or other polymer, but is should be understood that it is preferable to use a hard, stiff, lubricious plastic. In any event, shaft 174 of plug 180 is inserted through axial bore 172 and resilient body 152 so that head 184 abuts a stanchion in the form of annular ring 170. Plug 180 is held in position by means of a locking washer 190 that is press-fit onto shaft 174 so as to be engaged and held in position by vanes 182. To this end, washer 190 is provided with a central opening 192 to

receive shaft 174. Plug 180, along with the flexibility of central portion 153, provides a second active spring region to eject a container 22 from chuck assembly 130.

As is also shown in this Figure 4, as well as in Figure 3, central panel 153 has a plurality of equiangularly spaced, longitudinally extending vent passageways 157 that provide vents such that the interior of chuck element 130 may be vented when resilient element 150 is mounted on the end thereof. The use of vents 157 is desirable, on one hand, to prevent resilient element 150 from forming a suction cup when pressed against a lid 20. Should this happen, the suction force would act to resist ejection of the seamed container. Use of vents 157 does increase the possibility, however, of a small amount of lubricant leakage. Accordingly, depending on the application and risks involved, vents 157 may or may not be employed without departing from the scope of this invention.

The action of resilient element 150 on a container 22 can now be more fully appreciated with reference to Figures 6(a)-6(c) and Figure 7(a)-7(c). Referring first to Figure 6(a), it may be seen that container 22 and lid 20 engage chuck 120 in a fully engaged position. Here, the active first spring region 164 is compressed against lid 20 while central portion 153 of resilient element 150 is inwardly deflected because of the contact of plug 180 with lid 20. The amount of deflection is controlled by the thickness of head 184 and the thickness of ring 170. Figure 6(a) corresponds, diagrammatically, to a dual spring equivalent of resilient element 150 as is shown in Figure 7(a). In

Figure 7(a), it may be seen that a spring 210 is fully compressed between a first plate 220 and a second plate 230 spaced at a distance "l_1". Another spring 250 is fully compressed between plate 230 and a third plate 240 a distance "l_2".

Figure 6(b) shows the resilient element of chuck assembly 120 in an intermediate position. Here, the spring region 164 is decompressed thus partially ejecting, that is, disengaging, lid 20 of container 22 from chuck assembly 120. However, central region 153 remains substantially deflected. This, then, corresponds to the two spring equivalent diagram in Figure 7(b). In Figure 7(b), spring 250 remains fully compressed between plates 240 and 230 at a distance "l_2". However, spring 210 is decompressed so that plates 230 and 240 are spaced from one another a distance "l_3".

Finally, with respect to Figure 6(c), chuck assembly 120 and resilient element 150 are in a fully disengaged state or release state. Here, spring region 164 is fully expanded. Moreover, the spring region formed by the deflection of central portion 153 is now in its undeflected, or normal position. This, then, corresponds to the mechanical equivalent spring structure shown in Figure 7(c). In Figure 7(c), it may be seen that spring 210 is fully open so that plates 220 and 230 are spaced the distance "l_3" apart from one another. Spring 250 remains fully expanded so that plates 230 and 240 are spaced-apart an expanded distance "l_4".

From the foregoing, and in particular reference to Figures 7(a)-7(c), it may be seen that, as container 22 and unseamed lid 20 are

advanced into engagement with chuck assembly 120, spring 250 first compresses at a first spring force "F_1" that is equal to k_1 (l_4 - l_2) where "k_1" is the spring constant of spring 250. This compression occurs because "k_1" is much less than the spring constant of spring 210, that is, "k_2". Moreover, the compression of spring 250 corresponds to the deflecting of central wall portion 153 between the released position shown in Figure 6(c) to the intermediate position in Figure 6(b). Further advancement of container 22 and lid 20 into engagement with chuck 120 now results in the compression of spring 210. This corresponds to the compression of spring region 164 of resilient element 150. This second force exerted by this second compression, then, equals k_2 ($l_3 - l_1$).

With the spring equivalent diagrams of Figures 7(a)-7(c) in mind and with further consideration of the structure of resilient element 150, it may now be appreciated that resilient element 150 provides a dual action on a container 22 and its lid 20 both during engagement as well as for purposes of ejecting the assembled container from the forming station. When in the fully engaged position, spring region 164 exerts the larger spring force on lid 20 over a relatively short distance. It may be desirable that this force be approximately twenty to sixty pounds acting over a distance of approximately .010 to .060 inches. This force is provided by the compression of region 164 and acts to initially disengage the assembled container from the engaged position shown in Figure 6(a) to the intermediate position shown in Figure 6(b). Upon the expansion of region 164, however, a smaller force acts over a

longer distance. Here, the spring force is preferred to be approximately five to fifteen pounds acting over a distance of approximately 0.1 to 0.5 inches. This longer throw with less force accelerates the seamed container downwardly and helps overcome the frictional engagement of container 22 with the star-wheel apparatus.

A first alternative embodiment of the present invention is shown in Figure 8. In Figure 8, resilient element 350 is adapted to again mount in chuck assembly 120. Here, however, resilient element 350 is formed as integral one-piece molding of flexible, resilient, compressible polymer material. Accordingly, plug 180 is eliminated. Instead, central portion 353 has a head structure in the form of an enlarged external nub 360 with rounded surface 361 that is axially disposed so as to bear against lid 20. Vents, such as vent 357, are provided.

A third exemplary embodiment of the present is shown in Figure 9. Here, resilient element 450 is again formed as a single molded piece. However, central portion 453 is thickened to provide a greater ejection force and the axial nub 460 has a flattened top surface 462 instead of being rounded. In this embodiment, the vent ports are eliminated.

From the foregoing, it should be appreciated that the amount of the dual acting forces may be altered as should be readily apparent to those ordinarily skilled in the art. This can be accomplished, for example by changing the dimensions of shoulder 162 both in thickness and in radial dimension, by changing the thickness of region 164 and by changing the thickness of central region 153. The distance of throw

for the second spring force can be varied by changing the dimensions of plug 180 as well as annular ring 170. The amount of force can be altered by changing the thickness or dimensions of central region 153. In addition, cuts or other weakening structures such as annular channels could be used to alter the spring constant of the second spring force, all as should be apparent to the ordinarily skilled artisan.

Also based on the foregoing, it should be appreciated that the present invention contemplates a dual acting method of ejecting workpieces from forming stations. This method would be that contemplated by the steps performed by all of the structures heretofore described. Broadly, however, the method would entail providing a first and a second ejection force, of different magnitudes, such that the seamed container is ejected by applying a first force over a first distance and a second force over a second distance. In the exemplary embodiment, the second force would be a greater force for a lesser distance while the first force would be a lesser force for a longer distance.

Broadly, the method of the present invention comprises the steps of securing a resilient element in fixed relation relative to the chuck element in a manner such that a central portion of the resilient element will by contacted by deflected by the workpiece when the workpiece is moved into the intermediate position thereby to exert a first restorative force on the workpiece tending to eject it from the chuck element. Next, the positioning mechanism is advanced whereby the workpiece is moved from the intermediate position to the engaged

position simultaneously compressing a margin portion of the resilient element thereby to exert a second restorative force tending to eject the workpiece from the chuck element. The workpiece is then held in the engaged position against the restorative forces until the machining function is completed. Thereafter, the positioning mechanism retracts to allow the resilient element to rebound to eject the workpiece. The resilient element is constructed in such the first and the second restorative forces applied thereby are sufficient to eject the workpiece from the forming station after the machining function is preformed thereof. For example, the machine may be a lid seamer and the machining function according to this method is seaming a lid or other end enclosure onto a container body.

Accordingly, the present invention has been described with some degree of particularity directed to the exemplary embodiment of the present invention. It should be appreciated, though, that modifications or changes may be made to the exemplary embodiments of the present invention without departing from the inventive concepts contained herein.